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Considering Drowning, Drowning Prevention, and Learning to Swim

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Considering Drowning, Drowning Prevention, and Learning to Swim

I composed drafts of this editorial mainly while flying at about 36,000 feet (~11,000 m) over the continental U.S., the Pacific Ocean, and the South China Sea on my way to and from participating in the World Conference on Drowning Prevention (WCDP) 2011 in Danang, Vietnam. If this editorial seems less "lucid" than some I have written, I hope readers may chalk it up to low brain oxygen levels, cramped seating conditions, and/or jet lag. For those who dread flying such as my sister, Susie, I am just ignoring the fact that I am 7 miles above the earth's surface racing along at 550mph (850kmh) in a flimsy tube of aluminum theoretically held aloft due to forces associated with Bernoulli's principle!

Because of my participation at WCDP 2011, my thoughts have been consumed not with potential airplane crashes (or delays and missed flights of which there were plenty on the trip), but with the tragedy of drowning and the many ideas and proposals for dealing with this worldwide pandemic that emerged during this conference. Although the annual numbers of *fatal drownings* in the U.S. and many other high income countries (HIC) have slowly declined over the past 30-50 years, the estimated worldwide numbers remain staggering. Informed estimates put the range between 200,000 to 800,000 lives lost per annum. Most of the fatal drownings each year occur in low and middle income countries (LMICs), especially those in tropical regions such as Southeast Asia and Vietnam where water is omnipresent particularly during the monsoon season from September to December. It was widely publicized during WCDP that at least 300,000 annual fatal drownings occur in the LMICs. This tragic number was one of the stated reasons for holding the conference in Vietnam where there are a growing number of innovative and noteworthy learn-to-swim and drowning prevention programs underway.

Regular readers of *IJARE* may recall Kevin Moran's insightful article in the fourth volume describing the "iceberg phenomenon" associated with drowning wherein some estimates suggest that *non-fatal drowning* (the term the International Life Saving Federation strongly urges all of use to use instead of the older and less accurate "near drowning" usage) may occur at a ratio of 10:1 in relation to fatal occurrences. I recently read another survey reporting that a majority of respondents self-reported having had or knowing of a "near" or "non-fatal" drowning experience at sometime during their lifetime. I think we need to heed this high rate of non-fatal drowning because the difference between non-fatal and fatal may be less than a minute and some fortuitous occurrence such as bystander able to respond.

Barriers to Drowning

The Centers for Disease Control and Prevention (CDCP) in the U.S. as well as the U.S. Consumer Product Safety Commission (USCPSC) and other groups such as the National Drowning Prevention Alliance (NDPA) have proposed the concept

of "multiple barriers" between water environments and prospective drowning victims, particularly young children, ages 1-5 years. Young children represent the worldwide group that consistently suffers from the highest rates of fatal and non-fatal drowning. The multiple barriers proposal arose from the recognition that no single variable explains a majority of drowning experiences. The need for multiple barriers to water results from the fact that although we can identify a number of factors that contribute to drowning incidences (e.g., lack or momentary loss of adult supervision, excessive ease of access to water such as inadequate fencing around backyard pools or no childproof locks on windows or doors), none of them alone is sufficient to prevent drowning.

Of course, the well-intentioned recommendation to provide multiple barriers to water in home environments is probably overly simplistic when considering the worldwide incidence of fatal and non-fatal drowning, especially in the LMICs. As the WCDP program continually stressed, drowning most often results from a complex set of circumstances in different settings around the globe. Recognition of the complexity of drowning factors is indeed an important realization, albeit only a first step in a long journey for drowning prevention advocates, researchers, lifeguards, water safety experts, and other clinicians. The WCDP 2011, to be followed in two short years by another assembly in October 2014 in Potsdam, Germany, rightfully heralded the growing importance and acceptance of a regular "soap box" issue of mine in previous *IJARE* editorials: the need for a stronger and more comprehensive scientific evidence basis for our practices in swimming and drowning prevention.

Role of Learning to Swim and Water Competence in Drowning Prevention

As regular readers know, I am particularly interested in the role that learning to swim and competence in the water may play in drowning prevention. At first glance, having sufficient skill in swimming seems like a "no brainer" in the quest for a "magic bullet" in preventing incidences of drowning. There can be no doubt that knowing how to swim can be a powerful deterrent to drowning. While swimming skill may be an important, even a necessary, element in drowning prevention, it also is insufficient by itself due to the host of complex elements that contribute to the risk of drowning. Part of the reason for this insufficiency can be appreciated if one understands swimming, water competence, and drowning from developmental and dynamical perspectives.

Swimming as a Dynamical System

I would like to propose the perhaps radical proposition that skill or competence (sometimes inaccurately termed "ability") in swimming is *not* a capacity possessed in any static or permanent way by any individual. Our common way of speaking about our skillfulness in the water, "Yes, I can swim" or "No, I can't swim," reveals this traditional way of thinking about swimming. I suggest that "swimming" or "water competence" is an emergent and potentially transient systemic behavior, mediated by interactive relationships among a person's individual characteristics, their perceived goal(s) at any point in time, and the environmental context(s) in

which one finds herself. In other words, competence to swim surprisingly depends upon what kind of swimming I am intending to do and where. For example, I was once "competent" and "able" to swim 100 meters in under 1 minute, but I no longer can swim quite that fast despite daily training. Once I was competent to swim the distance of over 20 miles non-stop (maybe I still am, but I won't know until the next time I try) in one of the Finger Lakes; I seriously doubt if I am able to do that same distance in open water such as across the English Channel. These examples identify obvious examples of how my own personal competence has changed over time. While I would be quick to volunteer that "I can swim," that ought not be seen as a universal ability that I possess. At this very minute, as I write this from a seat in an airplane, I am unable to swim because there is not a body of water in sight, except perhaps 7 miles beneath my feet. When I get to an appropriate aquatic location (e.g., Bowling Green's Cooper Pool) and I attempt an appropriate task (e.g., swim 4000 m in Masters' practice), then I will at that time demonstrate that "I can swim." I realize that this may seem like mincing words or putting too fine a point on a subtlety, but it really is an important distinction when trying to understand a different perspective regarding what differentiates "being able to swim" in the context of drowning prevention.

Swimming Emerges From Constraints

Figure 1 should appear familiar to regular readers of my editorials. I probably overuse this model. It is a modification of Karl Newell's (1986) "constraints" model of motor coordination and control as I have adapted it to swimming and aquatic activity. The model supports my argument from the previous paragraph that swimming (and drowning) activities result from the application of dynamical systems to our thinking. Individual characteristics at the peak angle of the triangle illustrate the personal qualities that any human brings to aquatic endeavors. These include a person's size, body segment relative proportions, their force production capabilities, their body composition, the state of their nervous system including consciousness, and a host of other relevant abilities/disabilities. The bottom right angle of the triangle represents the conditions of the aquatic environment including the type of facility or lack of facility, the water depth, the water and air temperature and relative humidity, and even the presence of other aquatic life (e.g., stingers, sharks, seaweed). Finally, the bottom left angle of the triangle in Figure 1 represents the factors associated with the task(s) being performed in the water, including the swimmer's goal, presence of any equipment (e.g., goggles, nose plug, kickboard, hand paddles, wet suit, or even clothing), and any relevant external expectations or rules (e.g., competitive stroke rules, pool rules).

Importantly, each of the three factors in this model of swimming or drowning prevention are "connected" or "linked" by the sides of the triangle, representing the so-called "constraints" or relationships among the factors. According to Newell's model, it is the interaction among these relationships from which emerge swimming behaviors or conversely, drowning behavior. The arrows coming from the center of the triangle suggest alternative movement outcomes depending upon the constraint relationships that may occur. When a healthy, fit, and appropriately-experienced individual enters a guarded pool with intention, the model suggests that a certain kind of swimming behavior probably will emerge. Conversely, if the same indi-

vidual is unintentionally pushed into a Class 5 white water without a PFD, either swimming or drowning behaviors may emerge. Certainly if the same individual falls into any body of water while unconscious, it is most likely that drowning behavior will emerge. Regardless of how well we arbitrarily say the person "can swim," it is this complex set of interacting constraints that shapes different sets of probabilities toward swimming and/or drowning.

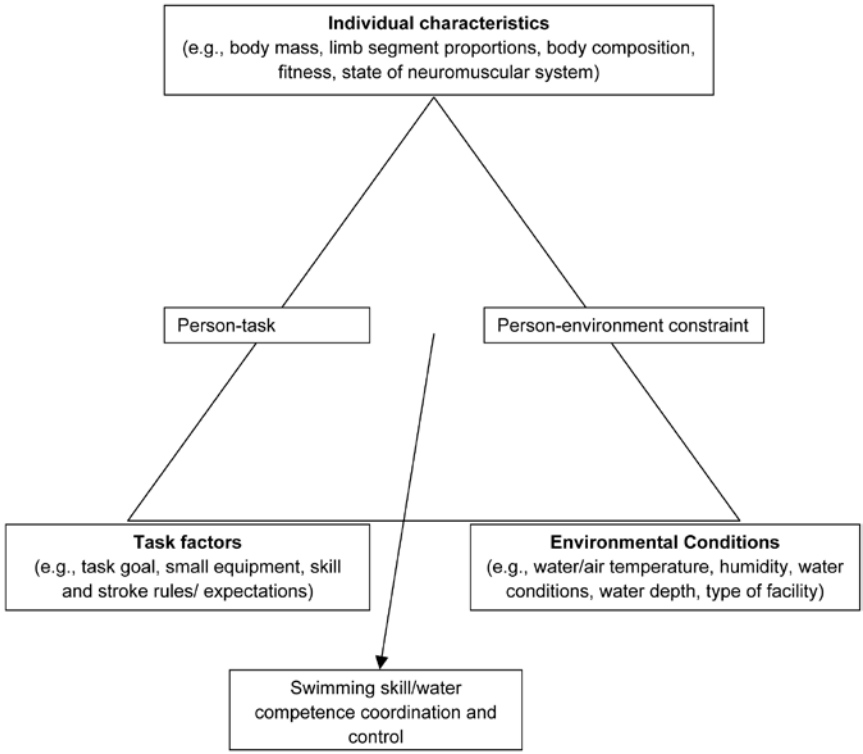

Figure 1 — Model describing how constraints modify a person's swimming skill or water competence as modified from Newell, K. (1986). Constraints on the development of coordination. In M.G. Wade & H.T.A. Whiting (Eds.), *Motor development in children: Aspects of coordination and control* (341-360). Dordrecht: Martinus Nijhoff.

Enabling and Disabling Constraints

Mary Ann Roberton and I a number of years ago introduced the concept of "enabling" and "disabling" constraints (Langendorfer & Roberton, 2005). We did this to clarify that constraints are not always synonymous with "restraints," but in fact are more related to the concept of "affordances" from the direct perception psychological literature. For example, an appropriately-sized flotation device such as a PFD "affords" floating behavior because as buoyant equipment, it creates an

enabling constraint with the person and density of the water to promote floating. In the same way, larger amounts of body fat create an enabling constraint with the aquatic environment to likewise support floating, if not swimming as well. In contrast, wearing clothing or footwear as well as having very low body fat both serve as disabling constraints to the act of efficiently traveling through the water (a.k.a., swimming) when they interact with the density of the water environment and create additional drag and reduced buoyancy.

Several presentations at WCDP 2011 pointed out that drowning is not unique to young children or persons who may be considered "non-swimmers." One presentation reported a study done in Norway, pointing out the paradox that sometimes even so-called "good swimmers" drown (Hindmarch & Melbye, 2011). If one presumes that swimming skill is a static personal "possession" or "capacity," then the drowning of a person with swimming skill makes little sense and is hard to understand. If, however, one understands that "swimming" is an emergent and dynamic state of behavior dependent not only upon certain individual characteristics such as sufficient buoyancy, fitness, body proportions, and a state of consciousness, as well as sufficient and prior experience in the water and motivation to swim, plus the presence of a water environment, then one might come to appreciate that as individual characteristics, motivation, and water conditions change, the state of "being able to swim" can change dramatically and rapidly.

Challenging Infant Drownproofing Programs

I expect many readers have received one of the videos widely circulated on the internet showing a fully-clad and unattended young child who opens a door at the back of his house and wanders to the unfenced backyard in-ground swimming pool. As the child tries to retrieve a floating beach ball, he loses his balance and plunges into the water. The video intends to illustrate how fortunate that child has been because he had been "taught" how to roll over onto the back and placidly float until help arrives. Authors of the video presumably expect that well-meaning parents, caregivers, or grandparents of young children will not be familiar with the importance of close and active parental supervision as well as the use of multiple barriers to a pool such as a four-sided fence with childproof locked gate, childproof lock on the exit door, or a pool alarm or cover (none of which were present in the video scenario). The video authors instead want viewers to accept their claim that the "drownproofing" program is both necessary and sufficient to prevent any child from drowning under the presumption that the young child now "possesses" the capacity, if not to swim, at least to roll over and float.

Don't Bet Your Child's Life on Drownproofing

I won't challenge the fact that *some* young children might be able to be conditioned to perform a back float in the manner illustrated in this internet promotional video. As I have published previously, the phenomenon of infants and toddlers rolling over on their backs was first reported by Myrtle McGraw in her 1939 paper in *Journal of Pediatrics*, "Swimming behaviors of the human infant" and later in her 1945 text, *Neuromuscular maturation of the human infant*. Online readers can play the

short digital video clip to observe what McGraw called "Phase 2," "disorganized behavior," of her identified sequence of infant swimming behaviors. Print readers will see a single still photograph (Figure 2) along with McGraw's drawing (Figure 3) of the three phases of swimming behavior of infants. I would ask readers to note that although these infants do roll over, they do not all hold still or maintain their faces above water as the internet video purports. I do strongly challenge the presumption by infant "drownproofing" advocates that all or most children can uniformly acquire and then perform this proposed "water proofing" skill given the wide variability in young children's behaviors as well as the vast range of conditions that exist to confound such simplistic representations of drowning situations. The likelihood of transferring their skill from one simple situation to another uncontrolled one has never been conclusively demonstrated with any scientific evidence. I would ask parents whether they want to take the chance that their young child might serve as an exemplar such as presented in the video or instead be one of the tragic thousands who drown? Acknowledging the limitations of any swimming approach as preventive and employing better supervision as well as installing multiple barriers is still the consensus and recommended method. Why not reduce the likelihood of the child even getting into the water rather than relying on an unproven method in case they do?

Figure 2 — Phase 2, disorganized behavior.

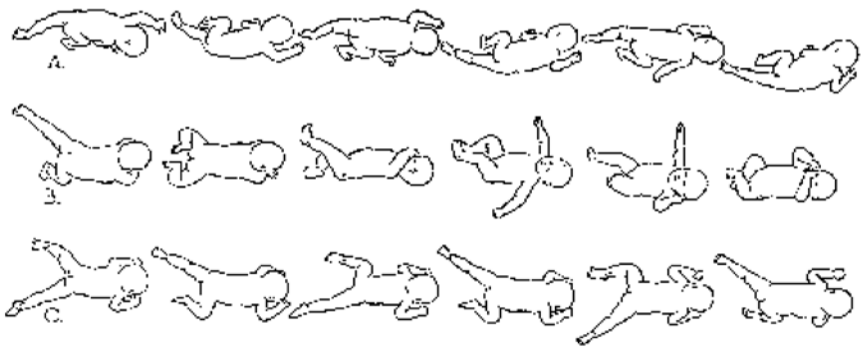

Figure 3 — "Three Phases in the Development of Aquatic Behavior in the Human Infant." From McGraw, M. (1945). *The neuromuscular maturation of the human infant.* New York: Columbia University.

Overestimating Competence

Based on my previous discussion about the dynamic and shifting nature of "can swim," I have a strong concern that the parents and caregivers of infants who have participated in swimming classes designed to "water proof" young children will be less diligent in supervising and providing multiple barriers to the water as a result of a false sense of security that the child possesses a certain reliable swimming "ability." A number of years ago, I conducted an unpublished survey of parents who enrolled their children in a university-sponsored learn-to-swim program. A vast majority of these highly-educated parents expressed the opinion in the survey that their child was in fact safer around the water after their 10 lessons. Interestingly, these parents made this claim despite the fact that our videos and personal observations of these same 10 lessons illustrated that the lessons had *not* significantly altered the child's swimming skill. It was good that parents were making a link between water safety and swimming skill. It was not so good that the children had not in fact improved their skill and that parents made an undocumented assumption about their child's improved skillfulness.

How Should We Define "Can Swim?"

The dynamic complexity of water environments and how individuals interact, either voluntarily or involuntarily, with the water causes me great concern with respect to how sufficient arbitrary levels of swimming skill serve as an adequate deterrent to drowning. As pointed out earlier, as a dynamic quality, swimming and water competence are complex and potentially fleeting behaviors given different situations and environmental conditions. We should not necessarily trust that a child's "possession" of swimming skill in one situation will necessarily transfer to another situation. This can be a huge leap of faith to presume that a child's performance on one day during swim lessons wearing a bathing suit in relatively warm water will automatically inoculate them to drowning in another situation when they are unsupervised, clothed, and suddenly plunged into colder water.

Water Competence Versus Skill in Swimming Strokes

Years ago Larry Bruya and I coined the term "water competence" as a more gender neutral term in place of "watermanship" (Langendorfer & Bruya, 1995). At the time, I am sure we did not really consider that either swimming or drowning were emergent behaviors. We made a similar oversight to many people by not carefully defining what we meant by "being able to swim" or being "water competent." It is obvious to me in hindsight that swimming skill and water competence are both relative behaviors whose requirements and functionality shift as the nature of the aquatic task and water environment changes. I am challenged along with my colleagues such as Bob Stallman from the Norwegian School of Sport Science to more appropriately define what it means to swim and to be water competent (Stallman, Dahl, Moran, & Kjendlie, 2011).

I leave a more comprehensive and functional definition for "can swim" to another day and another editorial. Despite its longevity these past 17 years, "water competence" as a construct and a practice needs to be better defined as well. I have always thought that water competence connotes a broader set of skills than simply "being able to swim," which too often is equated with performing strokes using specific coordination patterns. Obviously along with a clearer definition, we need to be studiously conducting a line of inquiry that explores the degree to which either "being able to swim" or "water competence" provides evidence for preventing drowning. Is either sufficient?

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